

THE CLAIMS

1. A method for forming a high-optical-confinement waveguide structure, the method comprising:

5 - forming a silicon-based waveguide on a substrate by depositing a waveguide layer comprising amorphous silicon onto the substrate;

wherein the waveguide layer has a refractive index which is greater than a refractive index of the substrate.

10 2. A method as claimed in claim 1, further comprising a step of depositing a first layer of a first material on a wafer so as to form the substrate prior to depositing the waveguide layer.

15 3. A method as claimed in claim 2, wherein the wafer comprises a silicon wafer.

4. A method as claimed in either claim 2 or 3, wherein the first layer is silica-based.

20 5. A method as claimed in any one of the preceding claims, wherein the step of forming the silicon-based waveguide further comprises etching the deposited waveguide layer.

25 6. A method as claimed in claim 5, wherein the etching is performed in a manner which forms a ridge structure in the deposited waveguide layer.

30 7. A method as claimed in any one of the preceding claims, wherein the method further comprises a step of

creating a refractive index variation in the deposited waveguide layer so as to form a non-constant refractive index profile in the waveguide layer.

5        8. A method as claimed in claim 7, wherein the step of creating the refractive index variation comprises exposing the deposited waveguide layer to radiation so as to induce refractive index changes in the deposited waveguide layer.

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9. A method as claimed in any one of the preceding claims, wherein the waveguide layer further comprises a dopant material.

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10. A method as claimed in any one of the preceding claims, wherein the deposited waveguide layer further comprises at least partially-oxidised silicon.

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11. A method as claimed in any one of the preceding claims, wherein waveguide layer is deposited by plasma-enhanced chemical vapour deposition (PECVD).

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12. A method as claimed in any one of the preceding claims, wherein the step of forming the waveguide further comprises forming a taper in an end portion of the deposited waveguide layer for facilitating optical coupling to an optical fibre.

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13. A method as claimed in claim 12, wherein the step of forming waveguide further comprises creating a variation of refractive index of the deposited waveguide layer in the end portion of the waveguide.

14. A method as claimed in claim 13, wherein the  
step of creating the variation of refractive index in the  
end portion comprises carrying out controlled oxidation of  
5 the end portion.

15. A method as claimed in claim 14, wherein the  
controlled oxidation comprises using a laser to heat the  
deposited waveguide layer.

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16. A method as claimed in claim 15, wherein the  
laser comprises a CO<sub>2</sub> laser.

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17. A method as claimed in any one of the preceding  
claims, wherein the method further comprises a step of  
forming an optical signal processing element in and  
integrated with the deposited waveguide layer.

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18. A method as claimed in claim 17, wherein the  
processing element comprises a photodetector incorporating  
a dopant material in the silicon-based waveguide  
structure.

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19. A method as claimed in claim 18, wherein the  
processing element is arranged to be controlled  
electrically to change its refractive index.

20. A method of coupling a silicon-based waveguide  
to an optical fibre, the method comprising:

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- oxidising the silicon-based waveguide in an end  
portion thereof so as to alter a refractive index of the  
end portion; wherein the end portion is arranged to  
facilitate optical coupling of the waveguide to an end of

an optical fibre, the oxidation being controlled so as to create a refractive index profile in which the refractive index at an outer end of the end portion matches that of the optical fibre.

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21. An optical device incorporating a silicon-based waveguide structure formed on a substrate, the device comprising a processing element formed and integrated with the silicon-based waveguide structure, wherein the silicon-based waveguide structure incorporates an amorphous-silicon-based waveguide layer.